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ABSTRACT

This exhibit was developed through an interactive display against a traditional phenomenological approach. The research report addressed in this paper focuses on informal science learning and points out the need for analyzing the large-scale data gatherings of museums and their visitors. The paper addresses the methodology involved in systematically finding meaning in the over 3,000 visitor responses to a controversial science exhibit called "A Question of Truth." The exhibit was designed by the Ontario Science Center (OSC) and attempts to demonstrate the cultural, personal, and political influences on science by the backgrounds of its practitioners. This paper mainly focuses on one study of four which involved a text analysis technique. These analyses help to understand visitors' responses and attitudes toward the presentation of an exhibit on subject matters such as truth, prejudice, race, bias, and social change in an informal setting. (Contains 35 references.) (YDS)

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Comment Cards and Visitors' Understanding of the Cultural Context of Science

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Introduction

The research reported in this paper has an informal science learning focus, and acknowledges the ongoing need to bring rigor to the qualitative research methodologies used to study museums and their visitors. At the same time, there is a need to acknowledge the unique nature of museum experiences, and the fact that some questions about museum usage may require altogether new methods. Museum staff often collect hundreds of visitor comments but rarely analyze the results of this large-scale data gathering. This paper will address the methodology that we evolved to systematically find meaning in over three thousand visitor responses to a controversial science exhibit called *A Question of Truth (AQT)*.

Our work is informed by nature of science (NOS) and science, technology, society and environment (STSE) education, constructivist learning theory, and text analysis of visitor meaning-making. This paper considers how analysis of responses from many visitors can help educational researchers and museum staff more richly understand individuals' informal learning experiences in a science center. We report on evidence of visitor meaning-making in a science exhibit that challenges dominant western views of science. Specifically, we focus our discussion of comment card analysis on issues related to truth, prejudice, bias, diversity, and difference as they relate to science.

Background and Purpose

The exhibit

In contrast to the unequivocal statements about the nature of science represented in the phenomenon-based displays usually found in science centres (McManus, 1992; Pedretti, in press), the Ontario Science Centre (Toronto) has created an exhibit that views science as a human and social activity located within culture and dominant worldviews. *A Question of Truth* was designed to examine several questions about the nature of science,

how scientific ideas are generated, and how cultural and political conditions affect the actions of individual scientists.

The exhibit attempts to demonstrate how science is influenced by the cultural, personal, and political backgrounds of the practitioners-- qualities that include bias, and points of view. The notion of social bias in science is demonstrated by examining various episodes in the history of the practice of science. 'Universal' beliefs of western science are challenged by offering a couple of examples that demonstrate the validity of alternative points of view from non-western scientific knowledge. As a result, a re-evaluation of the neutrality of scientific evidence and knowledge making (scientific epistemology) becomes the centerpiece of the exhibit.

The exhibit floorplan (Figure 1) is illustrated below— a star identifies the location of the comment card station. A central theatre orients the visitor to the general topics covered in the exhibit through a video concerned with context and consequences in our pursuit of scientific knowledge of the world. The general themes of *AQT* include points of view, science and race, science and prejudice, and science and the community. The intent of all the displays is to emphasize that the social context in which we work dictates the nature of the questions asked and the style of observation and theory-development adopted. This exhibit, and the accompanying visitor responses, provide support for alternative representations and portrayals of science.

Figure 1: *A Question of Truth* exhibit floorplan (star indicates the comment sheet station)

The research project

In a long-term multi-faceted project established in 1997, researchers working with principal investigator Dr. Erminia Pedretti at the Ontario Institute for Studies in Education of the University of Toronto, have been looking at visitor responses (casual and school visitors) to *AQT*. This is an unusual exhibit in that, unlike most science centre exhibits, it is issues-based rather than phenomenologically oriented. *AQT* challenges the notion of objectivity in the history of Western science, and suggests that alternative models found in non-western scientific traditions likewise have their uses. A central theme in the exhibit is the assertion that science is culturally and socially situated.

In the first study, researchers examined senior high school students' evolving understandings of the nature of science and scientific practice. These understandings developed both through their experiences at the exhibit and through classroom instruction on the nature of science (Pedretti & Forbes, 1999). A second study investigated visitors' understandings of the nature and practice of science and their response to this exhibit. A third study explored visitors' understandings and interpretations of the health display in the exhibit.

This paper focuses on the fourth study, which used a text analysis technique to analyze 3,365 visitor comment sheets collected within the exhibit space over a three-year period. We discuss the method used to analyze thousands of visitor comments and find patterns and meaning in these large amounts of qualitative data. In part, analysis of these comment sheets helped us to better understand: (1) individual visitor responses to exhibits/ displays that confront issues such as truth, prejudice, race, bias, and social change, in relation to science and culture; and, (2) visitors' attitudes about the type of subject matter that should and should not be presented in an informal learning environment (i.e., a science centre).

Theoretical and Methodological Perspectives

Two strands of research inform this project. The first strand comes from an interest in informal learning environments (i.e., science centres and museums) as sites for learning

about science in its social, cultural, and political context. The second strand relates to the analysis of visitor responses (written or drawn comment sheets) as documentation of visitor meaning-making (see for example, Falk & Dierking, 2000; Silverman, 1995, 2000; and Worts, 1990, 1995).

Science Centre Experiences and *A Question of Truth*

Traditionally, science centres or museums develop their exhibits around a phenomenological approach (i.e., light, sound, gravity) and information is structured through interactive displays. As McManus (1992, p.164) explains, science centres typically pose "a decontextualized scattering of interactive exhibits, which can be thought of as exploring stations of ideas," usually presented in small displays or galleries. However, little attention has been paid to the applications of science and their ethical implications for society, while even less consideration has been given to science as the outcome of particular social processes and contexts.

During the past twenty years or so, nature of science (NOS) and science technology, society and environment (STSE) education have become part of science education discourse (e.g., Aikenhead & Solomon, 1994; Kumar & Chubin, 2000; Pedretti 1999; Solomon, 1993). Both place science in a larger social, cultural and political context. STSE extends this to include decision-making and action, often through the exploration of socio-scientific issues (Pedretti, 1997; Watts, Alsop, Zylersztajn & Maria de Silva, 1997), while NOS emphasizes the tentative, fallible and subjective character of science (Cobern, 1998; Lederman, 1992; McComas, 1998).

Recent discussion in science museums is also evolving to include social responsibility, the raising of social consciousness, and science, technology, society and environment issues. Science museums are beginning to see themselves as important players in a number of external scientific, social, cultural and political contexts. This is being reflected in various kinds of programming initiatives, for example, collaborating with the school system on the development of science curricula (Smithsonian), or the initiation of different sorts of community advisory committees. Issues-based exhibitions have been developed, inviting visitors to actively participate, consider socio-scientific

issues from a variety of perspectives, and critique the nature and practice of science and technology. Some such recent installations include *A Question of Truth* at the Ontario Science Centre (the subject of this paper), *Science in American Life* at the Smithsonian Institution of Washington, *Mine Games* at Vancouver's Science World, and *Birth and Breeding* at the London Wellcome Institute. *A Question of Truth* provides opportunities for visitors to re-examine their epistemological positions-- or thinking about science as a philosophy of knowledge-- and to reflect on a socio-cultural perspective of science.

Constructivism and Visitor Meaning-Making

Critical issues-based exhibits often reflect constructivist principles by: (1) challenging visitors to explore issues of relevance to their own lives, (2) presenting a multiplicity of views (that are often also at odds with one another), and (3) presenting multiple entry points for engaging with the ideas displayed.

Glasersfeld (1989) describes constructivism as "*how* the knowledge that 'enables us to cope' is arrived at" and Piaget as "the most prolific constructivist in our century" (1989, p. 125). Piaget (e.g., 1967) argued that knowledge is never acquired passively because new knowledge can only be handled through assimilation to a cognitive structure an individual already has. In social constructivist thinking, learners are active and adapt to the world by forming and reforming categories and structures that work to explain the phenomenal world and allow the learner to interact with it effectively (O'Connor, 1998). Therefore, learners are thought to be active creators of their knowledge. They build up or 'scaffold,' piece by piece, an internal mental structure that is made up of pieces that preexisted. Individuals rely on this structure in reorganizing their activity on the basis of further experience. Glasersfeld (1993) explains that knowledge has to be built up by each individual learner. It cannot be packaged and transferred from one person to another. Learners are always assimilating information from the world and accommodating to the world by creating new knowledge structures. Ausubel, Novak, and Hanesian (1978, p.iv) affirm that "The most important single factor influencing learning is what the learner already knows."

Jeffery-Clay (1998) believes that museums are ideal constructivist environments because they allow visitors to explore freely, move at their own pace, interact and share experiences with groups, and examine and expand their own understanding. Hein (1998, p.34) concurs that constructivist exhibitions provide opportunities for learners "to use both their hands and minds, to interact with the world, to manipulate it, to reach conclusions, experiment, and increase their understanding; that is, their ability to make generalizations about the phenomena with which they engage." Conclusions reached by visitors as learners are validated by whether the conclusions 'make sense' within the constructed reality of the learner.

Roberts (1997), however, argues that museums also construct their own versions of reality that may help or hinder visitors from developing their own interpretations about objects, displays, and exhibitions. Osborne (1998, p.8) cautions that some of the ideas that museums wish to present are "strange, unfamiliar, and antithetical to common sense." Rice (1998, p.11) discusses how 'cognitive dissonance' can result when an object or piece of information in a museum does not fit into a visitor's pre-existing structures; "When the mismatch occurs, most people are tempted to reject the perceived reality and stick to their own structure, thus reducing the cognitive tension." The corollary of this is found in research by Weltzl-Fairchild, Dufresne-Tassé, and Poirier (1995), who report museum experiences where there is a 'fit' between a visitor's schemas and objects-- what Zusne (1986) has termed 'consonance.'

Making Sense of Visitor Meaning-Making

Visitor responses to museum exhibits may be studied using a wide variety of methods. Williams and Rubenstein (1994) survey the use of visitor studies and evaluation in Canadian museums. Binks and Uzzell (1999) offer an overview of strengths and weakness for evaluation techniques most commonly used in museum audience research. Although comment sheets/ cards are commonly collected, comment sheet analysis does not make either the Williams & Rubenstein list or the Binks & Uzzell list of methods commonly employed to study museum visitors and the meanings they attach to exhibits. Hein (1998) also reports the fact that many museums collect comment cards from visitors

but that only some use them. This is unfortunate as comment sheets offer an available (and so, cost-effective) resource for evaluation, and a rich source of ideas about visitor concerns. They can also be used comparatively, alongside other data sources, to provide richer information about visitor responses to exhibits and programs.

Visitor comments generally represent a self-selecting sample of the visitor population, and so in general, "the key to turning information on comment cards into evaluation data lies in developing a systematic collection and analysis scheme" (Hein, 1998, p.118). Even without systematic collection, anonymous comment cards are, however, an especially appropriate method for examining visitors' ideological critiques of exhibits, as it tends to be visitors with "strong emotional or ideological responses"-- one way or another-- who bother to fill in comment cards (Pekarik, 1997, p.57). As Pekarik points out, while visitors may welcome the opportunity to write and respond to comments, museum staff may see little use in reading them, and worse, "an isolated eloquent negative or positive comment can easily lead to misinterpretation of the overall audience response" (1997, p.56).

Despite their potential as a museum evaluation resource, the literature search for this study found only two publications (Pekarik, 1997; Worts, 1995) that offer analyses of visitor comments. Worts (1995) looked at 5,000 cards left in response to the works displayed in the historical Canadian art hall of the Art Gallery of Ontario. In this case, the comment cards were blank pieces of cardstock imprinted with the invitation: "Share your Reaction." Most respondents left drawn rather than written responses. Staff and consultants then looked at the cards with the goal of improving their knowledge of variations in visitor experiences in exhibits. Although a specific methodology is not detailed, it would appear that cards were mainly scanned for interesting or recognizable images. Worts concludes that the "range of responses is quite remarkable-- and they display a kind of personal insight into the art experience that the Gallery itself could not articulate" (1995, p.175).

Given the limitations of comment sheets for representing a statistically valid survey of audience opinion (the goal for many evaluation studies), Pekarik (1997, p.58) poses an essential question: "What can be done with these hundreds of thousands of comments?"

In an effort to expand their female audience, the Smithsonian Institution National Air and Space Museum (NASM) recently displayed a small temporary exhibit entitled *Flight Time Barbie*. The gender issues associated made this an interesting exhibit to study, but visitor comments offered the only feasible means of visitor study available to understand visitor reactions. To this end, a comment form was created with three questions: Were you surprised to find this here? What did you think of the exhibit? What comments do you have? Demographic information requested at the bottom of the form included gender, age, residence, number of visits to the NASM, and number of Barbies owned (Pekarik, 1997, p.59). 1,766 comments were received and the demographic information collected demonstrates that the respondents have a very different profile than the average NASM visitor. Nine out of ten comment forms were filled out by women, and six out of ten forms were completed by visitors under age 19.

The textual statements on the NASM comment forms were input into a computer and the content coded for meanings using QSR NUD*IST qualitative analysis software. Statements may have been given multiple codes, and the coding structure was reorganized as coding categories emerged or merged over the course of the analysis (Pekarik, 1997).

AQT comment sheets had both prescriptive and open-ended aspects to their design. These comment sheets were designed as an activity to stimulate visitor engagement with ideas, rather than as an evaluation tool. While the desk housing the sheets and pencils displayed a list of provocative questions a visitor might choose to take up in their written response, the comment sheets themselves were blank (with the exception of the exhibit letterhead). Although unaware of Pekarik's article until the final stages of the data analysis, the methodology we developed to categorize 3,365 comment sheets shares many similarities to the approach and suggestions he offers.

Beyond the museum sources cited above, our methodology has been influenced by educational research (Denzin and Lincoln, 2000) and communications research (Krippendorff 1980) embracing content / text analysis. Krippendorff (1980) defines content (or text) analysis as follows: (1) it is an unobtrusive technique; (2) it can use

unstructured material, for example, where the researcher looks at previously generated material; (3) it is context sensitive; and, (4) it can handle large volumes of data. Having more than 3,000 previously generated and unstructured comment sheets to analyse, as they relate to a complex exhibit and our own previously generated visitor data, text analysis was the best suited method for our purposes.

Methods

Unlike the comment cards used in the studies reported on by Worts (1995) and Pekarik (1997), the comment sheets in this study were not purposefully designed to capture data for evaluation research, but simply to offer visitors an activity-- an opportunity to reflect and offer feedback while in the exhibit space. We decided, therefore, to look at the visitor comment sheets as they were an available source of rich data that, when combined with the findings of the prior studies conducted on the same project, could potentially offer fuller insights into visitor learning. The analysis technique was shaped by: (1) the unstructured nature of the comments; (2) the experimental nature of the inquiry within the context of the project as a whole; and, (3) the research resources available. Had we designed the comment sheet for the purpose of our study, or been able to scan the comment sheets and use qualitative analysis software a more sophisticated analysis would have been possible.

Visitors to *AQT* were given the opportunity to fill out an anonymous comment sheet and drop it in a box near the end of the exhibit. For the purpose of this study the Ontario Science Centre lent us two banker boxes full of visitor comment sheets, consisting of all the comments received during the first few years of the exhibit's display (November 1996- December 1999). This included comments from the initial installation in the ground floor Great Hall (a temporary exhibits gallery) as well as the subsequent permanent installation in the lower level Communications Hall. Some sheets were bound with a note listing OSC tallies of "positive" and "negative" comments. The process we used to make sense of this large volume of comments in terms of our own research interests is summarized below.

Each comment sheet was manually sorted into only one dominant category. In many cases two or more categories may have been appropriate, however, time and the large quantity of data did not allow cross-referencing for each comment. The data can neither support specific claims about individual visitor experiences and meaning-making, nor make statistically representative claims about trends across the entire visitor population. As a result, we decided to simply scan the comments for the most representative/ descriptive categories of types of concepts visitors spoke to in their comments.

Our initial sorting procedure was to create piles consisting of comments we all agreed to be "useless" or "useful." Criteria for these categories were agreed upon as follows: useless comments were flippant/ obscene/ silly or indecipherable/ scribbles, and any not obviously directed to the particular exhibit. Any other comments constituted the initial "useful" pile. Those commenting on the science centre generically, for example, were later removed from the 'useless' to the 'useful' pile as a separate category. For comparison purposes, such piles were made independently for both the Great Hall and the Communications Hall. This constituted the first reading of the entire set. "Potentially useful" and "foreign language" piles also emerged during the initial sort. The initial sort gave us 893 'useful' comment sheets (26.5% of the total sample). The 'useless' comment sheets (N= 2,472) were set aside.

Following the first reading, the research team brainstormed temporary categories for the initial useful pile sub-sort by with the prior *AQT* visitor research in mind. Three researchers then read and reread the comment sheets a number of times in a negotiated sorting process. Keywords and definitions for each category were identified from the outset. As the sort continued, further categories emerged and initial categories were expanded. Emergent categories later called for resorting of some previously sorted comments into the new categories. Thus, our methodology is reflective of a "constant comparative method" (Merriam, 1998).

To reduce the amount of work involved, we had decided from the outset to focus on the Communications Hall comments (as our own visitor research had been conducted after the exhibit was moved to its permanent space in the museum), and select Great Hall comments from a discrete timeframe for comparison. We began sorting out categories

using the box that was labeled as just containing Communications Hall comments. We later realized, however, that the remaining sheets were not clearly differentiated between installations, and that the numbers found in just one box were too small for demonstrating any trends in the categories on which we were interested in focusing. The second box of sheets was then merged, and sorted into the categories we had defined using the first box. This added time to our analysis process, but did not result in revisions to the categories that had already emerged. The ratio of useless/ useful tallies ultimately reflected a more realistic number (1,069 [32%] useless/ 2,296 [68%] useful where N= 3,365) than the idiosyncratic numbers that represented only comments originally of interest to us. The complete list of categories and merged tallies is given below in Table 1.

As we read and reread, some initial categories were split. 'Cultural diversity/ Difference', for example, thanks to the number and variety of comments included, became four separate categories over the course of the sorting process. Some categories were subdivided into thematic subcategories, to identify trends. Comments related to 'This exhibit is educational,' for example, had three subcategories, including good for personal learning, good for school use, and generally educational. Many other preliminary categories or tentative subcategories were subsequently merged, and some were later subdivided differently. In some cases previously sorted comment sheets were resorted into new categories that offered a better fit, as the reading and rereading continued. Throughout the process, tallies for each of the piles were noted at the end of each sorting session so that the sheets, new categories, and running totals were kept in order.

In order to clarify our use of terms in comparison with what might be meaningful for an exhibit visitor, the annotated exhibit floorplan was consulted to (a) consider visitor use of terms (e.g., "civilization") in relation to the exhibit, and (b) to identify and organize the range of comments related to specific or favorite displays (e.g., various terms were used to identify the boxes of memories).

Categories and numbers from the initial sorting analysis were looked at in a second brainstorming session. Categories that had both numerous comments and greatest significance for our study were identified. This favoured themes that were thematically

related to findings for the preceding study on the Health section of the same exhibit. The following five key categories emerged from our preliminary analysis and became the focus for the secondary analysis:

- Bias
- Diversity/ Difference/ Equality
- Prejudice/ Discrimination/ Racism
- Social Change
- Truth.

These categories are represented as the predominant themes in 527 (23%) of the 2,296 'useful' comment sheets and indicate the socio-cultural perspectives about science to which visitors responded during their experience in the exhibit. The sheets from these categories were then alpha-numerically coded on the back for use in referencing quotations.

The category 'Truth' was scanned for dominant themes. Using the types of themes found in this category as conceptual subcategories, an analysis grid was generated to sort exceptional quotes (or find gaps) for each category by theme. Further analysis of the five key categories was attempted using the conceptual grid to identify representative quotes for each type of subcategory. Upon analysis of the other four key categories, however, it was found that this method would not work. The types of themes found in the truth category were too disparate and unlike those found in other themes, and so the conceptual grid devised for the secondary analysis had to be abandoned.

Rather than trying to conceptually cluster the subcategories *across* each key theme, each subcategory was scanned for representative quotes, with attention to the fact that there were a range of *positive, negative* and *neutral* orientations or attitudes within many subcategories. Throughout the sorting process any comments one of the readers found exceptional or spoke well to the category were tagged. In a final scan of all sheets in the five key categories we selected quotes representative of the thematic trends found in each category, and positive, negative or neutral positions within them. Mirroring the initial sort process, a second reader was consulted to compare impressions regarding the representativeness of the comments selected for quotation.

Findings and Discussion

Many visitors in the sample (958, or 42% of the 2,296 useful comments) did choose to comment in some way on the quality of the exhibit or their science centre experience. These comments included those on favourite displays (4.1%), suggestions (7.1%), omissions (1.5%), whether they liked the exhibit (5.6%) or did not like the exhibit (1.0%), liked the science centre as a whole (16.9%), the exhibit as being educational (4.9%), and whether or not they liked science in general (0.5%). The other 1,338 (58.3%) 'useful' comments, however, do not speak to visit satisfaction or exhibit effectiveness so much as they spoke to visitor meaning-making (or meaningless-making!). Within this majority of comments is evidence of a broad range of questions raised, conceptual associations made, and philosophical orientations on the part of the sample of visitors who actually took time to write feedback.

The initial impetus for analyzing the visitor comment sheets was to compare their content with the sorts of responses visitors gave during our interviews in the research project's earlier studies. Although there was neither information about the visitors who filled out a comment card in *AQT,* nor a specific context for their comments based on their experience in the exhibition, the comments submitted provide some insight into individuals' pre-existing ideas about science. In some cases, the comments also indicate whether the exhibition created cognitive consonance or dissonance with visitors' pre-existing knowledge about science, and science content that people expected to see displayed in an exhibition at a science center.

The list offered in Table 1 offers a breakdown of the categories that emerged in our analysis of the responses and illustrates all categories and subcategories that emerged in our analysis. As this analysis relied on manual sorting, each sheet was only sorted into one category/ subcategory. As a result, the numbers given represent only the number of comments sorted into categories based on the predominant theme of the text, not the total number of comments making any reference to a given notion. Many comments spoke to a number of themes, but complex coding was beyond the scope of the analysis technique adopted here. So again, as Worts (1995), Pekarik (1997) and Hein (1998) note, comment

sheet analysis is useful to demonstrate the *range* of visitor opinions rather than their statistical representativeness across the total visitor population. The relative numbers can further be said to *suggest* the relative weight visitors do (or do not) give various ideas represented in the exhibit.

Table 1: Final Sort Categories and Totals for AQT Visitor Comment Sheets*

	Category	Number of Responses	Percentage of Responses	Total Responses
Useful Comments				**2296** (68% of total sample)
Focus of Inquiry	**Social change**	**23**	**1.0**	**527** (23% of useful comments
	Bias	**54**	**2.4**	
	Truth	**131**	**5.7**	
	Diversity/Difference/Equality	**143**	**6.2**	
	Prejudice/Discrimination/Racism	**176**	**7.7**	
Quality of Exhibit/ Science Centre	**Liked exhibit**	**128**	**5.6**	**958** (42% of useful comments)
	Omissions:	**35**	**1.5**	
	Political geography/ ethnicity	11		
	General	10		
	Religion	7		
	Sexuality	4		
	Gender	3		
	Favourites/specific display	**95**	**4.1**	
	Entrance	10		
	One race section	4		
	Health section	2		
	Points of view section	4		
	Community section	19		
	Prejudice section	47		
	Multiple (3 or more)	9		
	Educational	**112**	**4.9**	
	Personal learning	27		
	General	73		
	On school use	12		
	Suggestions/corrections	**164**	**7.1**	
	Suggestions - intellectual	38		
	Suggestions - practical	44		
	Suggestions - call for permanent ex.	7		
	Suggestions - call for travelling ex.	6		
	Corrections	11		
	Improvements for the science centre	58		
	On science centre generally	**388**	**16.9**	
	is fun/ I like...	264		
	is educational	71		
	dislikes/ complaints/ this sucks	53		
	Comments on science generally:	**13**	**0.5**	
	negative (I don't like science)	3		
	positive (I like science)	10		
	Did not like exhibit/exhibit not effective	**23**	**1.0**	

	Category	Number of Responses	Percentage of Responses	Total Responses
	Pondering/confused	**23**		
Other Meaning-	**To/on other visitors/comment**	**55**	**1.0**	**811**
Making/	**sheets**		**2.4**	(35% of
Meaningless	**Responding to questions posted at**	**33**		useful
Comments	**station**		**1.4**	comments)
	Medicine	7		
	Environmental concern	**3**	**0.3**	
	Gender	**17**	**0.1**	
	Foreign Language	**49**	**0.7**	
	Drawings	**195**	**2.1**	
	Scribbles	**201**	**8.7**	
	Profanity	**205**	**8.8**	
	Sexual innuendo	**23**	**8.9**	
			1.0	
Useless	Nonsense text	1,026		**1,069**
Comments	Blank	43		(32% of total sample)
Total Comment				**3,365**
Sheets				(100%)

***NB**: Because of the nature of our sorting technique, the above totals reflect only the *dominant* categories for each response, not the overall frequency of responses by category.

The largest number of comments in our focused analysis were in the the 'Prejudice/ Discrimination/ Racism' category (7.7%) and the 'Diversity/ Difference/ Equality category' (6.2%. The 'Bias' and 'Truth' categories (2.4% and 5.7% respectively) offer some of the most eloquent and verbose responses of the entire sample. Comments in the 'Truth' category were particularly interesting and fall within four conceptual themes: (1) Truth as absolute; (2) Truth as relative; (3) Truth as personally defined; and (4) Popular culture associations. These are expanded upon below.

The following are representative quotes from the dominant themes under each of the five key analysis categories. *Within* categories there are both a range of *subcategories* (conceptual themes) and a range of *positive/ negative/ neutral attitudes* toward the concepts expressed. Space does not allow us to demonstrate the full range of responses found within each category using illustrative quotes. Instead, single examples and the definitions that were used to define the categories are given to note the sorts of notions represented within the responses for each of the five categories focused on. Responses in

the 'Truth' category were especially diverse—and speak to the very name of the exhibit--and so that category has been given particular attention in the treatment of illustrative quotations below.

Social Change (N= 23/ 2,296, or 1.0 % of the 'useful' responses)

Comments in the social change category were defined as ones speaking to the desire for change or action in response to systemic discrimination. These comments also often spoke to the historical development of inequalities. The systemic analysis distinguishes these comments from those in the Diversity/ Difference, and Prejudice/ Discrimination/ Racism categories, as within those categories the social analysis made is on a more local/ personal level. One response in the social change category read as follows:

> It is not a question of race: the people who provide money and jobs, be they Black, Chinese, Aboriginal, or Martian for that matter, control our society. Historically, this role has been filled by people from Northern Europe, who still hold the reins of power. They have been running the world since colonial times. Even though Canada has been a recognizable separate entity from Britain for over one hundred years, many Canadians still look to England for leadership.
>
> Canadian immigrants, from Asia, the Middle East, the West Indies, South American, etc, perceive this power structure both as a threat and as a challenge-- the summit being the intended goal. It's natural to want to control your own world, but there is your neighbour, who doesn't want your domination extending to him. That's the problem: to allow people to control their own destiny without giving up control of your own. That's why the handing over of power takes so long-- hundreds of years-- because of the importance of a stable passing.

Bias (N=54/ 2,296, 2.4 % of the 'useful' responses)

Bias comments emerged as a category distinct from the Truth comments as they spoke to broader epistemological considerations than epistemologically-oriented responses that remain in the Truth category (see below). Keywords in the Bias comments are: bias, political correctness, propaganda, and pseudoscience. In these comments the authors/ visitors aim to clarify a personal definition of science or the scientific method, while offering implicit critique on the social role of science and science centre exhibits. The 'positive' responses in this category include the following comment:

> I believe this exhibit is complimentary to the science centre because it shows how bias affects our interpretation of not only society, but science. Despite the common belief that science is objective it is based on assumptions. Assumptions and interpretation of scientific data is subject to preconceived notions & bias. In this sense, this exhibit might awaken people to biases that the rest of the scientific exhibits in the science centre are based on.

Many visitors expressed discomfort or outright hostility at the inclusion of an exhibit offering a social analysis of science, as the following 'negative' Bias comment demonstrates:

> I came to the science centre to learn about science. Not to have my intelligence insulted with yet more politically correct propaganda. What you present in this exhibit is the obvious. Not interesting & not scientific.

Diversity/ Difference (N= 143/ 2,296, 6.2 % of the 'useful' response)

Comments in this category spoke generically about diversity or difference and tended to offer statements such as "people should love their differences" or "diversity is beautiful." Many comments in this category are both positive and couched as personal testimonials supporting a position on accepting diversity. The remarks in this category tended to be positive, like the following comment:

> I think that culture differences and skin colour are only as important as you make them. If scientists keep saying things about how humans are all genetically similar and skin colour does not mean anything it will take a long time to filter into people's psyche. The best example of such "colour blindness" was a story that a friend told me about a teacher. He had a class of about 15 people all of mixed race. He randomly told one of the students to cover her eyes. He asked, "Don't peek, but tell me how many black people there are in the room." The student's answer was "I don't know." This story illustrates something that I think not all people are willing to accept- not everyone is fixated on colour, race, nationality. Unfortunately these people are being overshadowed by those that want to make a huge issue of it.
>
> Thanks for the great exhibit.

Prejudice/ Discrimination/ Racism (N= 176/ 2,296, 7.7 % of the 'useful' responses)

Critiques similar to those found in the Difference category were offered in the Prejudice category. The comments in this category, however, offer a more diverse range along the positive/ negative/ neutral spectrum of positions and are more political in

nature. A number of comments are neutral in their response to the exhibit specifically and offer personal testimonies on the subject, some offering, for example, explanations for discrimination. Two examples of this are:

> Prejudice is part of life because people are afraid of what they don't know.

> Discrimination is a disease of perception. One must be taught to hate. Education is key.

Many of the negative comments (i.e., in tone or in relation to the point of view taken by the exhibit narrative) offered personal explanations intended to validate social discrimination. Among the range of comments supporting racism to some degree was following:

> This exhibit looks like a sneaky anti-racial indoctrination used by communist, not all of us agree with the equality of races "supported" by different amounts of melatonin in skin. Its not only melatonin but also mental capability which distinguish different races.

Truth (N= 131/ 2,296, 5.7 % of the 'useful' responses)

Many visitors spoke directly to the name and organizing idea of the exhibit, invoking the keyword "truth" in their comment. Some comments contested/ engaged with the Objective notion of Truth as an absolute. Others specifically discussed Truth and scientific validity. Some visitors reflected on relevant personal experiences. Still other visitors reflected on science as a social agent. Comments speaking to notions of, or personal definitions for, Truth fell into four conceptual themes:

(1) Truth as absolute and comprehensible as
    (a) empirical facts/ scientifically validated,
    (b) honesty, or
    (c) God/ Allah's plan;
(2) Truth as relative;
(3) Truth as personally defined in terms of relevant personal experiences; and
(4) Popular culture associations (e.g., quoting "The truth is out there," from the *X-files* television show).

A sample quotation from each of the 6 subcategories (themes) follows:

Truth as comprehensible through empirical facts/ scientifically validated:

> This exhibit promises much more than it delivers. A great shame-- because emphasizing truth in science-- separating fancy from fact-- are essential in this day of pop-science. The PC bug infected its authors; it is a disappointing effort, and ultimately fails. Sorry!

Truth as comprehensible through honesty (evidence and trust):

> What is the truth, is it the facts or is it what someone tells you? E.g., they told you O.J. Simpson killed two people, they also told you those two people were dead. How do you know that these people were dead did you witness the murder? Did you see the corps (sic)?

Truth as comprehensible through faith in a Creator:

> In a world full of individual opinion and moral and intellectual relativism people are looking to science for absolute and objective truth. Unfortunately we are "barking up the wrong tree."
>
> We need to be reminded of the words of the brilliant young scientist Blaise Pascal who discovered, after much success in physics and mathematics that science is just "a giant cul de sac." A playground that offers no real answers to the ultimate questions of life.
>
> The whole exhibit is very well layed out and its authors are to be commended. The title "A Question of Truth" is reminiscent of the words of Pilate to Christ: "What is truth." I believe the only begotten son of God is the only source of ultimate truth.

Truth as relative:

> "Truth" does not exist. It is a philosophical/ cultural construct, usually used for the purposes of furthering viewpoints of those with the power to create their truth.

Truth as personally defined:

> Truth is what you believe, and no one else cares about.

Popular culture and Truth:

> The truth is out there. *(written twice)* The X file.

Conclusions and Implications for Future Research

Our findings highlight the dominant themes that resonated with visitors as they engaged with this exhibit. Complex exhibit concepts linking science and social bias, ethnic diversity, prejudice, social change, and truth, clearly found a strong connection with a number of visitors, causing them to take pause and write passionate positive or negative comments. Some responses were neutral and demonstrate a weighing of 'pros and cons' in their consideration of the exhibit and the ideas presented. Individuals discussed personal experiences and provided reflections on science as a social agent in relation to race, religion, or other differences.

These findings confirm prior research into visitors' perspectives on science. Observation and interview data from an earlier study on *AQT* indicated that science center visitors are interested in considering science and the socio-cultural context in which it operates. In-depth interviews conducted with fifty people, revealed visitors' receptiveness to discuss with us issues related to the nature and practice of science. Science and culture, accountability, and social responsibility emerged as dominant themes. Furthermore, in examining the data from the fifty visitors, an overwhelming number of respondents (92%) strongly supported the inclusion of this exhibit at a science center, challenging traditional, rule-bound views and representations of science (see Pedretti, McLaughlin, MacDonald, and Gitari, in press, for a more detailed account of the visitor views shared in the in-depth interviews at the same exhibit).

As the above quotations demonstrate, visitors linked a broad range of notions to their reflections on the content of *AQT*. Beyond testing for visitor satisfaction, analyses of anonymous comment sheets are useful for examining visitors' ideological critique of exhibits—in this case, including issues related to the nature of science-- and can provide a rich source of ideas about science centre visitor concerns and attitudes (Hein, 1998). Text analysis is a useful method for unstructured material such as visitor comments, especially where the researcher is looking at previously generated material (Krippendorff, 1980). The fact that text analysis is context sensitive is especially significant for the

singular nature of museum exhibits. Our research methodology suggests that it is an effective way to handle large volumes of qualitative visitor data in a flexible manner.

Pekarik (1997) conducted a purposeful, smaller scale study using comment cards designed with closed questions and requesting demographic information. The categorical data collected was easily input for use in data analysis software, making the process much less laborious. Such a *prescriptive* technique, however, cannot offer the richness and breadth of associations found in the open-ended/ unstructured visitor comments that we looked at for this study. While our analysis was time-consuming, the results are much richer and demonstrate a naturalistic range of meaning-making and ideological responses. The data generated by prescriptive categories tends to be more limited in terms of the range in understanding of visitor meaning-making allowed. Further, where prescriptive visitor surveys are already conducted within the same institution, analyses of open-ended responses may provide unexpected and useful visitor feedback to compliment existent visitor data. So, the tools influence the findings significantly and a museum should carefully consider the questions they eventually wish to pose of their visitor comments when designing a comment sheet.

Analysis of comment sheets can be done variously and for different purposes, but one way or another offers a readily available and under-utilized museum resource for better understanding visitor meaning-making related to science. Beyond demonstrating a range of perspectives on the content presented, analysis of comment sheets can also offer insights into what issues and perspectives visitors feel science centres should and should not display. While a number of visitor comments demonstrated a pondering or undecided personal position in relation to the philosophy of science embraced in the content of *AQT*, many other visitors were very clear about what they thought was and was not appropriate subject matter for a public science centre to present. Looked at alongside the suggestions offered in comment sheets, such visitor feedback can be useful to future exhibit development/ redevelopment and programming.

In summary, comment sheets-- unstructured or involving closed or Likert-type scaled questions-- are a useful and under-utilized source of information on visitor meaning-making. Comment sheets represent a self-selecting visitor population, and so, looked at

on their own, the comments do not demonstrate representative trends for an exhibit or museum's visitors as a whole. Where the *range* of visitor understandings and associations are of interest, or visitor *opinions* untempered by face-to-face interactions with an interviewer are needed, unstructured forms such as those used in *AQT* are appropriate. Further, the inclusion of demographic questions at the bottom of a form purposefully designed for visitor research would not likely preclude free-form response. It would, however, allow somewhat more specific analyses regarding responses from different *types* of visitors.

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